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2 1. A process for removing heavy metals from water comprising the steps of:
3 introducing magnetite to a quantity of water containing at least one heavy metal;
4 mixing the magnetite with the water such that at least a portion of the heavy metal
5 in the water is bound to the magnetite;

6 removing the magnetite and bound metal from the water by application of a
7 magnetic field.

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9 2. A process for removing metal from water as defined in claim 1 wherein
10 application of a magnetic field comprises the step of flowing the water through a solid
11 magnetized matrix such that the magnetite magnetically binds to the solid matrix.

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13 3. A process for removing heavy metals from water as defined in claim 2 wherein
14 the superficial velocity of the water through the matrix is in the range of from about 0.5
15 cm/sec to about 2.0 cm/sec.

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17 4. A process of removing heavy metals from water as defined in claim 2 wherein
18 the superficial velocity of water through the matrix is about 1 cm/sec.

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20 5. A process for removing metal from water as defined in claim 2 wherein the
21 magnetic field is produced by remnant magnetism in the solid magnetic matrix.

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23 6. A process for removing metal from water as defined in claim 5 wherein the solid
24 matrix is steel wool which has been subjected to magnetism prior to being placed within the
25 water such that it displays remnant magnetism.

1 7. A process for removing metal from water as defined in claim 5 further
2 comprising the step of applying an external magnetic field to the matrix structure while water
3 is flowing through the matrix.

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5 8. A process for removing metal from water as defined in claim 1 wherein said
6 heavy metals are selected from the group consisting of transition metals, actinides, and
7 lanthanides.

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9 9. A process for removing heavy metals from water as defined in claim 2 further
10 comprising the step of removing the magnetite and bound heavy metal from the matrix by
11 reversing fluid flow through the matrix.

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13 10. A process for removing heavy metals from water as defined in claim 9
14 wherein the reverse fluid flow comprises air mixed with water.

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16 11. A process for removing heavy metals from water as defined in claim 9 wherein
17 the reverse fluid flow comprises water.

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19 12. A process for removing heavy metals from water as defined in claim 9
20 wherein the reversed flow through the matrix has a superficial velocity in the range of from
21 about 2 cm/sec to about 10 cm/sec.

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23 13. A process for removing heavy metals from water as defined in claim 9 further
24 comprising the step of collecting and disposing of the magnetite and bound heavy metal
25 removed from the matrix.

1 14. A process for removing heavy metals from water as defined in claim 1
2 wherein the step of introducing magnetite to a quantity of water comprises adding a quantity
3 of pre-formed magnetite to the water.

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5 15. A process for removing heavy metals from water as defined in claim 1
6 wherein the step of introducing magnetite to a quantity of water comprises adding an
7 effective quantity of Fe(II) ions and an effective quantity of Fe(III) ions to the water such
8 that magnetite is formed within the quantity of water.

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10 16. A process for removing heavy metals from water as defined in claim 14
11 wherein at least a portion of the heavy metal is adsorbed onto the magnetite surface.

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13 17. A process for removing heavy metals from water as defined in claim 15
14 wherein at least a portion of the heavy metals are bonded within the magnetite structure.

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16 18. A process for removing metal from water comprising the steps of:
17 introducing an effective amount of iron (II) ions and iron (III) ions into water
18 containing a heavy metal such that magnetite is formed and further such that said heavy
19 metal is bonded to the magnetite structure;
20 removing the magnetite and bonded metal from the water by application of a
21 magnetic field.

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23 19. A process for removing metal from water as defined in claim 18 wherein
24 application of a magnetic field comprises the step of flowing the water through a solid
25 magnetized matrix such that the magnetite magnetically binds to the solid matrix.

1 20. A process for removing heavy metals from water as defined in claim 19 wherein
2 the superficial velocity of the water through the matrix is in the range of from about 0.5
3 cm/sec to about 2.0 cm/sec.

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5 21. A process of removing heavy metals from water as defined in claim 19 wherein
6 the flow rate of water through the matrix is about 1 cm/sec.

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8 22. A process for removing metal from water as defined in claim 19 wherein the
9 magnetic field is produced by remnant magnetism in the solid magnetic matrix.

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11 23. A process for removing metal from water as defined in claim 19 wherein the
12 solid matrix comprises steel wool which has been subjected to magnetism prior to being
13 placed within the water such that it displays remnant magnetism.

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15 24. A process for removing metal from water as defined in claim 19 further
16 comprising the step of applying an external magnetic field to the matrix structure while water
17 is flowing through the matrix.

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19 25. A process for removing metal from water as defined in claim 18 wherein said
20 heavy metals are selected from the group consisting of transition metals, actinides, and
21 lanthanides.

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23 26. A process for removing heavy metals from water as defined in claim 19
24 further comprising the step of removing the magnetite and bound heavy metal from the
25 matrix by reversing fluid flow through the matrix.

1 27. A process for removing heavy metals from water as defined in claim 26
2 wherein the reverse fluid flow comprises air mixed with water.

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4 28. A process for removing heavy metals from water as defined in claim 26
5 wherein the reverse fluid flow comprises water.

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7 29. A process for removing heavy metals from water as defined in claim 26
8 wherein the reversed rate through the matrix has a superficial velocity in the range of from
9 about 2 cm/sec to about 10 cm/sec.

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11 30. A process for removing heavy metals from water as defined in claim 26
12 further comprising the step of collecting and disposing of the magnetite and bound heavy
13 metal removed from the matrix.

14

15 31. An apparatus for removing heavy metals from water comprising:
16 a water conduit for introducing water containing heavy metals into the apparatus;
17 a conduit for introducing a quantity of magnetite or magnetite precursors into the
18 apparatus;

19 a mixing chamber wherein the water containing heavy metals is mixed with the
20 magnetite such that at least a portion of the heavy metals are bound to the magnetite;

21 a magnetic separator configured such that magnetite is removed from the water by
22 application of a magnetic field;

23 an outlet conduit from conducting water out of the apparatus.

24

25 32. An apparatus as defined in claim 31 wherein a solid matrix is positioned
26 within the magnetic separator.

1 33. An apparatus as defined in claim 32 wherein the solid matrix displays remnant
2 magnetism.

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4 34. An apparatus as defined in claim 33 further comprising a source of external
5 magnetism in magnetic communication with the matrix such that the matrix displays a
6 magnetic field.

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8 35. An apparatus as defined in claim 31 further comprising a conduit for introducing
9 a fluid in reverse direction to the direction of flow of the water such that said fluid removes
10 magnetite and bound metal from the matrix.

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12 36. An apparatus as defined in claim 31 wherein the water conduit is selected such
13 that the water superficial velocity through the magnetic separator is in the range of from
14 about 0.5 cm/sec. to about 2 cm/sec.

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